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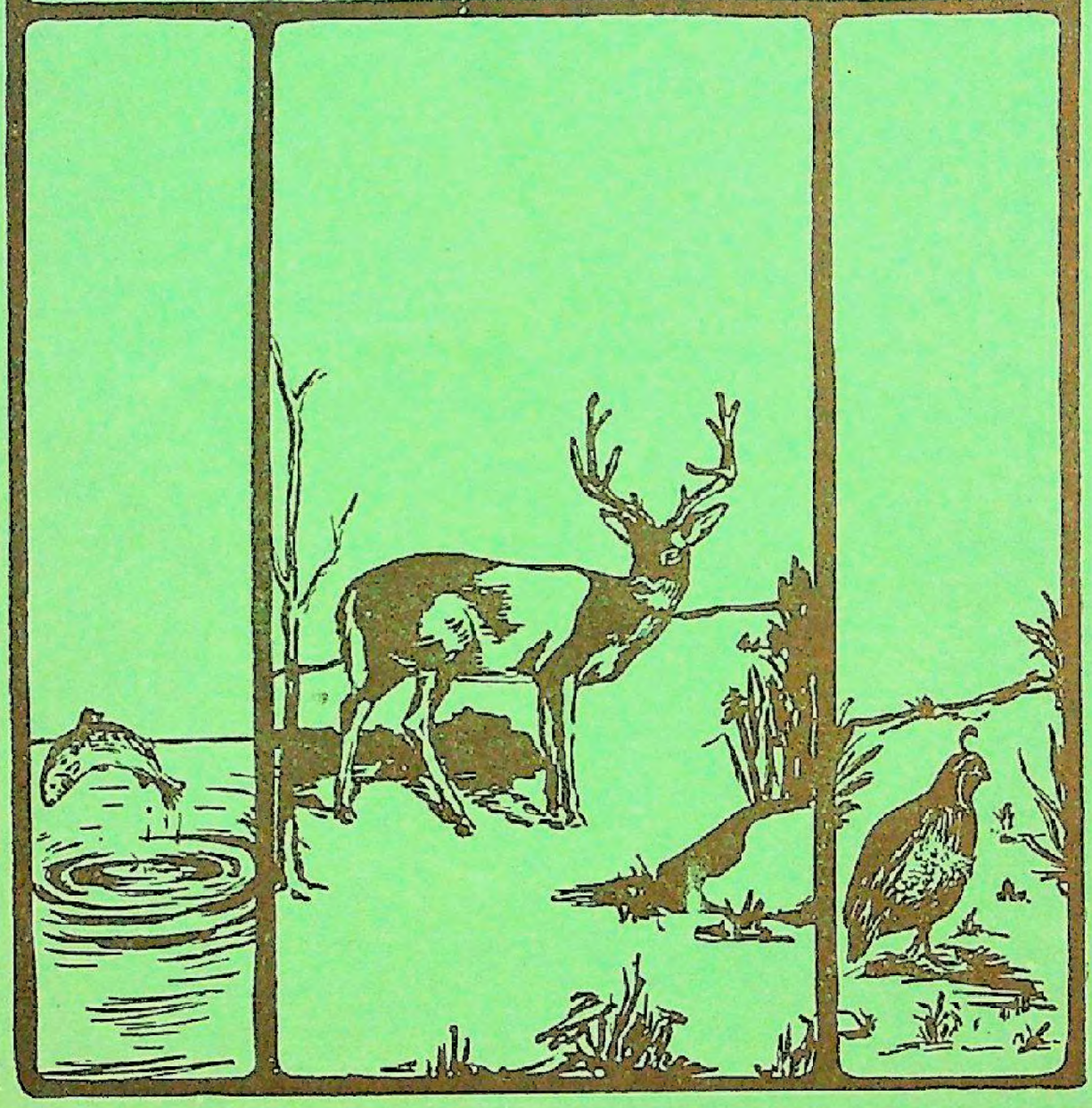

50438

William P Dearman

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DEPARTMENT OF NATURAL RESOURCES

DIVISION OF FISH AND GAME

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(Continued on inside back cover)

CALIFORNIA FISH AND GAME

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OXYGEN CONSUMPTION OF TROUT AND SALMON [1]

By PAUL SHAW
Terminal Island Sea Foods, Ltd.

Experimental Work: Methods and Results

A detailed study on the oxygen consumption of trout and salmon under varying conditions and temperatures was made at the Forest Home, Basin Creek, Lake Almanor and Kings River hatcheries of the California State Division of Fish and Game in 1933 and 1934. This material has not previously been published.

The method of determining the oxygen consumption of fish consisted of holding a weighed quantity of the fish in a small experimental trough approximately 2 feet in length and 8 inches wide, and passing through this trough a quantity of water which could be accurately measured by means of a graduated cylinder and a stop watch. After making such measurement samples of water were taken at the inlet and outlet of the trough and the oxygen content of each determined. From the decrease in oxygen content, the rate of water flow, and the total weight of fish, the oxygen consumption for the existing temperature could be computed. These values have been calculated in terms of cubic centimeters of oxygen per ounce of fish per hour. Control tests with reduced oxygen content and no fish present showed that any error in the above method due to surface reabsorption of oxygen in the small experimental trough was negligible in comparison to oxygen consumption by fish at the weight loadings used.

Table 1 covers the details of all tests made at the four hatcheries with different species of trout and salmon. To summarize these data, it may be stated that in general the oxygen consumption at any given temperature for the various species is very nearly the same, but that rainbow perhaps exhibited a slightly higher consumption or use of oxygen and Loch Leven a somewhat lower amount, the eastern brook and salmon being intermediate. The variations that occur in oxygen consumption for any one species, depending on the activity of the fish, are far greater than the variations between species. Thus, any unusual condition such as weighing and transferring of the fish, or feeding, will greatly increase their oxygen consumption and, on the contrary, quietness or starvation will reduce their oxygen consumption.

The most startling fact to be found from this series of tests is the marked increase of oxygen consumption with temperature. Minimum, normal and maximum rates of oxygen consumption expressed in cubic centimeters per ounce per hour for temperatures varying from 45-68° F. are shown in Figure 1. From this chart it will be noted that where the normal consumption is 3 cc per ounce per hour at 45° F. this value rises to nearly 12 cc per ounce per hour at 68° F., or an increase of 400 per

[1] Submitted for publication July, 1945. Mr. Shaw prepared and wrote this paper while serving the California State Division of Fish and Game as Chemical Engineer.

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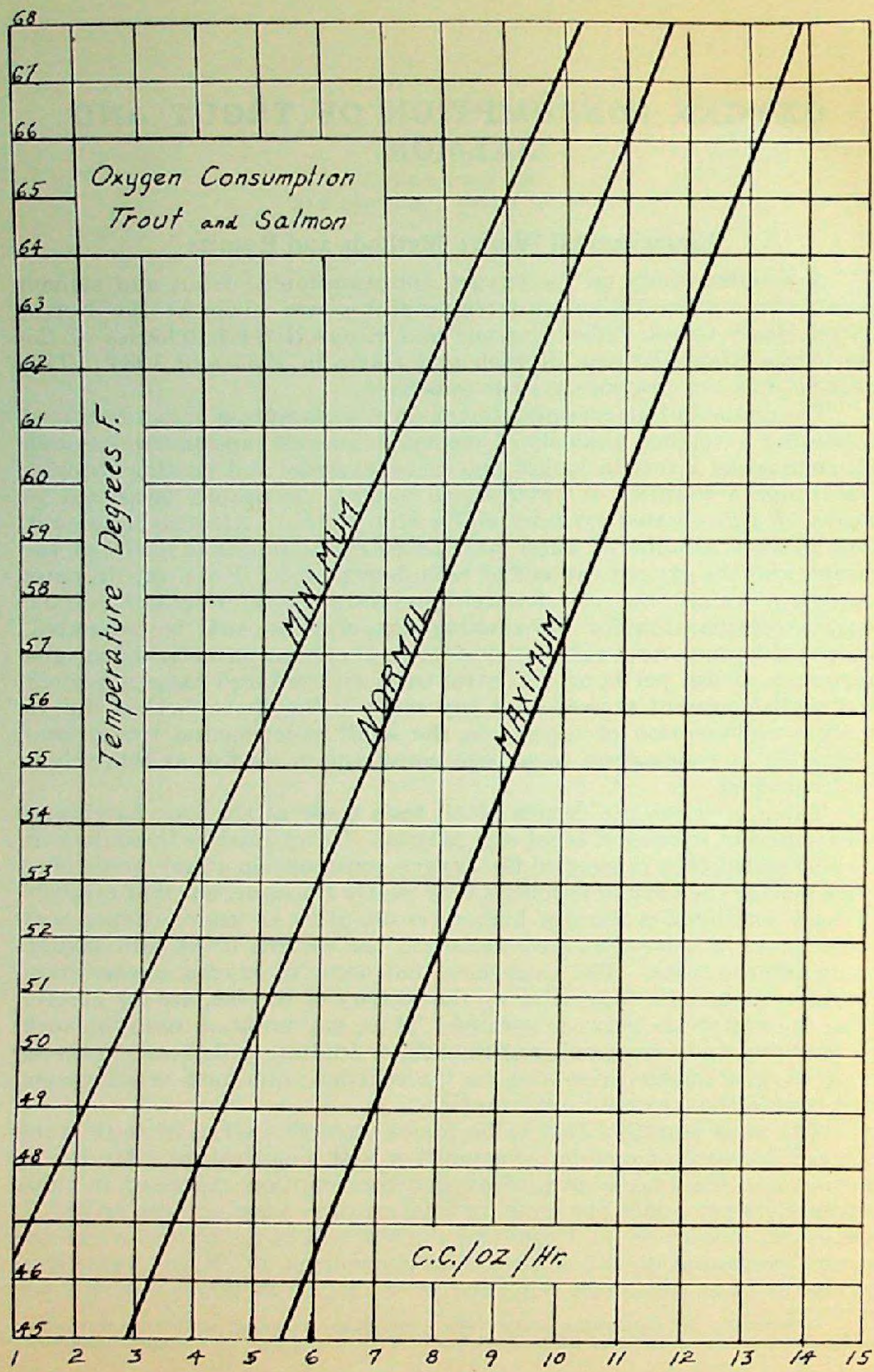
Oxygen Consumption
Trout and Salmon
Temperature Degrees F.
MINIMUM
NORMAL
MAXIMUM
C.C./OZ/Hr.
68
67
66
65
64
63
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FIG. 1

TABLE 1

Oxygen Consumption of Trout and Salmon

Species	Location	Size. fish per oz.	Time, hours	Temp., °F.	Oxygen used cc/oz./hour	Remarks
Rainbow	Forest Home	167	1.5	47	5.3	
			2.5	47	4.9	
			4.5	47	4.4	
			5.5	47	4.1	
			22	46	4.1	
			24	46	4.6	Fed
Rainbow	Forest Home	2.2	1	47	5.4	
			2	47	5.4	
			3	47	5.4	
			20	46	1.8	
			21	47	2.0	
			22	47	3.8	Fed
Rainbow	Forest Home	95	1	49	6.4	
			2	49	5.8	
			3	49	5.1	
			22	48	4.0	
			24	49	4.2	
Rainbow	Forest Home	15	3	53	6.4	
			4	52	5.8	
			5	52	5.6	
			22	50	4.9	
			23	52	6.6	Water supply changed
			24	53	6.3	
			26	54	5.8	
			29	53	6.0	
			46	51	4.1	
			47	52	5.4	Fed
			48	53	5.4	
Rainbow	Forest Home	6.4	3	53	7.0	
			4	52	6.7	
			5	52	5.9	
			22	50	5.5	
			23	52	7.0	Water supply changed
			24	53	6.4	
			26	54	7.2	
			30	53	5.4	
			45	51	4.8	
			46	52	5.3	
			47	53	5.6	
			70	52	4.2	
			72	54	4.3	
			75	54	5.5	
			94	52	3.3	
			118	52	3.7	
			120	52	3.6	Transferred by pouring. Not taken out of water.
Rainbow	Basin Creek	45	1.5	65	13.8	
			2.5	67	14.0	
			3.5	68	13.7	
			4.5	69	12.7	
			23	62	9.3	
			24	63	8.7	
			25	64	8.3	
			26	66	10.8	
			27	68	10.3	
			28	69	9.9	
Rainbow	Basin Creek	28	1.5	65	11.5	
			2.5	67	12.2	
			3.5	68	12.7	
			4.5	69	11.5	
			23	62	7.5	
			24	63	8.2	
			25	64	9.0	
			26	66	9.9	
			27	68	10.3	
			28	69	9.5	

TABLE 1—Continued

Species	Location	Size: fish per oz.	Time, hours	Temp., °F.	Oxygen used cc/oz./hour	Remarks
Loch Leven	Almanor	49	2	55	7.8	
			3	56	7.4	
			19	45	2.5	
			20	46	2.9	
			22	48	3.1	
			24	51	5.1	
			25	53	5.2	
			26	55	5.2?	
			27	54	5.6	
Loch Leven	Forest Home	2.3	1	47	4.5	
			2	47	4.6	
			3	47	4.4	
			20	46	4.0	
			21	46	3.4	
Loch Leven	Forest Home	0.9	1	47	4.0	
			2	47	4.9	
			3	47	2.9	
			21	46	1.1	
			22	46	1.4	
Loch Leven	Forest Home	163	1	49	4.6	
			2	49	4.5	
			3	49	3.7	
			22	48	3.6	
			24	49	3.7	
Loch Leven	Kings River	200	1	54	7.5	
			2	55	6.8	
			3	55	6.5	
			19	49	4.1	
			21	51	4.2	
			23	54	5.0	
Loch Leven	Forest Home	8	½	54	6.0	
			3	54	6.3	
			22	52	5.6	
			46	52	4.3	
			48	52	5.1	Water flow low.
			50	53	5.2	Water flow low.
Eastern Brook	Almanor	32	2	55	6.8	
			3	56	6.5	
			19	45	4.4	
			20	46	3.5	
			22	48	3.5	
			24	51	5.1	
			25	53	5.4	
			26	55	6.5	
Eastern Brook	Kings River	138	1	54	7.3	
			2	55	7.5	
			3	55	7.1	
			20	49	5.1	
			22	51	5.0	
			24	54	5.8	
Salmon	Almanor	11	2	55	7.9	
			3	56	7.6	
			19	45	2.8	
			20	46	3.2	
			22	48	3.8	
			24	51	5.2	
			25	53	6.3	
			26	55	6.4	
Salmon	Forest Home	68	2.5	48	3.8	
			4	47	3.9	
			22	46	2.6	

TABLE 1—Continued

Species	Location	Size: fish per oz.	Time, hours	Temp., °F.	Oxygen used cc/oz./hour	Remarks
Salmon	Forest Home	43	1	49	5.6	
			2	49	6.0	
			3	49	5.9	
			22	48	4.1	
			24	48	4.6	
Salmon	Forest Home	3	3	53	4.6	
			4	52	4.6	
			5	52	4.5	
			23	52	5.0	
			26	54	4.7	
			29	53	3.6	
			46	52	2.8	
			47	53	2.4	
			70	52	4.6	Water low. Fish in distress.
			72	54	3.1	
			94	52	3.8	

cent. This increase in oxygen use with rising temperature is of extreme importance in determining the carrying capacity of troughs, ponds and transportation facilities and the data should be made use of in considering proper hatchery design as will be later discussed.

Figure 2 brings out the changes in oxygen consumption that occur after weighing and transfer and also shows the increase that occurs when the fish are fed. Two curves are shown, one for very small fish, 167 per ounce; the other for relatively large trout weighing two per ounce. In general, the larger fish show a consumption somewhat less than smaller fish, but exhibit a greater fluctuation due to change in activity such as that occurring during feeding or transferring and weighing. Their oxygen consumption at these critical times reaches a level equal to that of the smaller fish, so that in calculating the carrying capacity of troughs and similar data it may be considered that consumption of the two sizes is nearly identical.

Figure 3 is of considerable interest as it shows the marked and continued decrease in oxygen consumption that occurs for a period of four days without any feed and is indicative of the benefit and increased carrying capacity that might be obtained in transportation of fish through keeping them off feed for a considerable period of time. While oxygen consumption increases greatly when fish are weighed out and transferred, and does not go down to a normal value for several hours, it is possible to transfer fish without causing an increase in oxygen consumed if they are moved by pouring and not actually taken out of the water. This is shown in a portion of Table 1 covering studies on rainbow trout 6.4 per ounce at Forest Home. Where transportation facilities are limited this benefit could be derived by weighing out fish the night before and transferring them into a small holding tank. Then for transportation merely allow the water from this tank with the fish to be discharged into the carrying tank or cans.

A change in the character of the water supply will also cause an immediate rise in oxygen consumption, as shown under remarks in Table 1, rainbow 15 and 6.4 per ounce at Forest Home.

The complete data as secured are given in Table 1 so that further studies of this information may be made if it is desired to interpret cer-

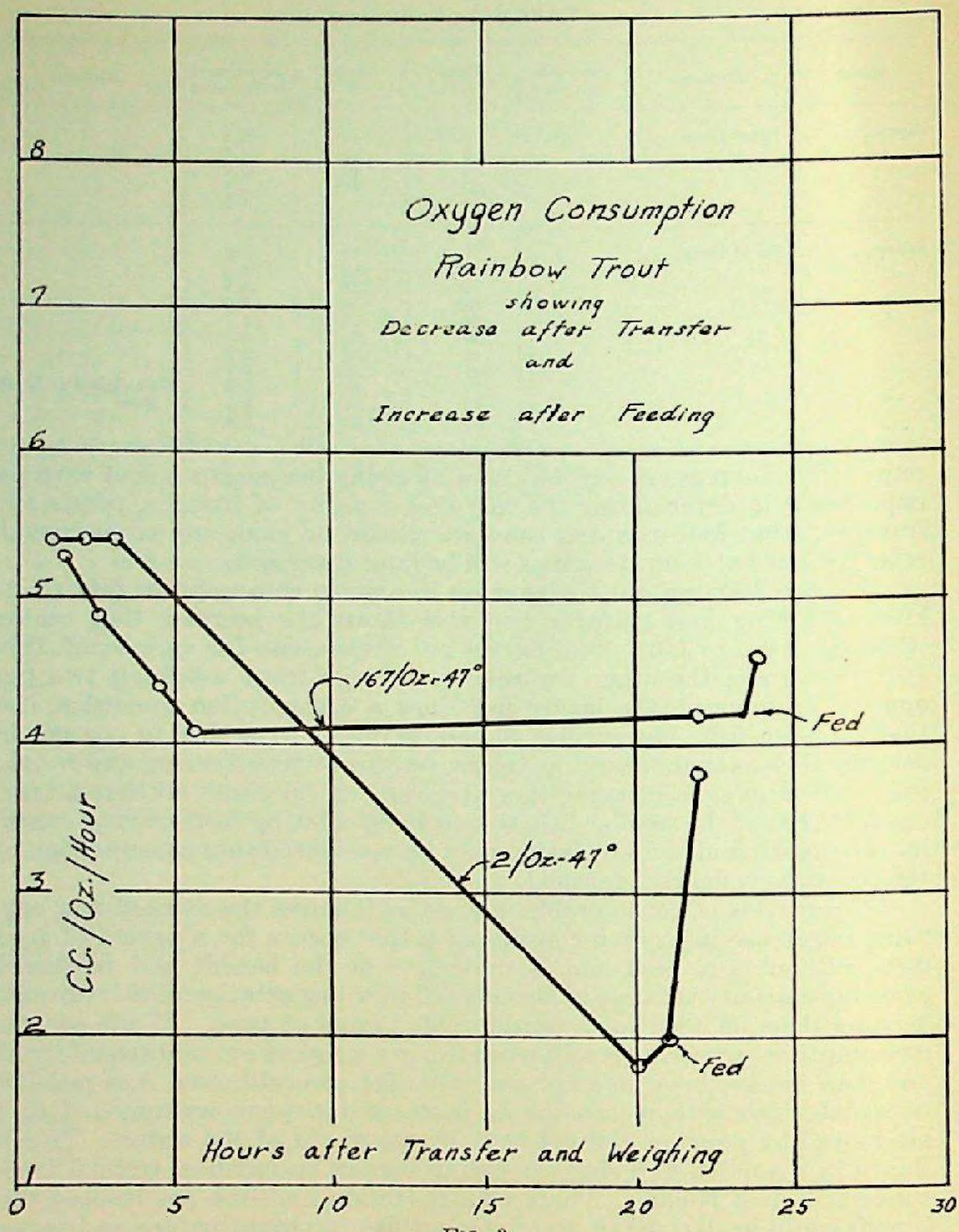

FIG. 2

tain factors on oxygen consumption in more detail than is given in the above summary.

Fish Carrying Capacity of Hatchery Water Supplies in Relation to Temperature, Altitude and Oxygen Consumption

For the purpose of studying oxygen consumption data, the known values of dissolved oxygen in parts per million at the saturation point for

varying temperatures and altitudes have been calculated for a portion of the temperatures to their equivalent quantity in terms of cubic centimeters per gallon of water and are shown by 5° F. intervals in Table 2. This table is for the purpose of utilizing the oxygen consumption data

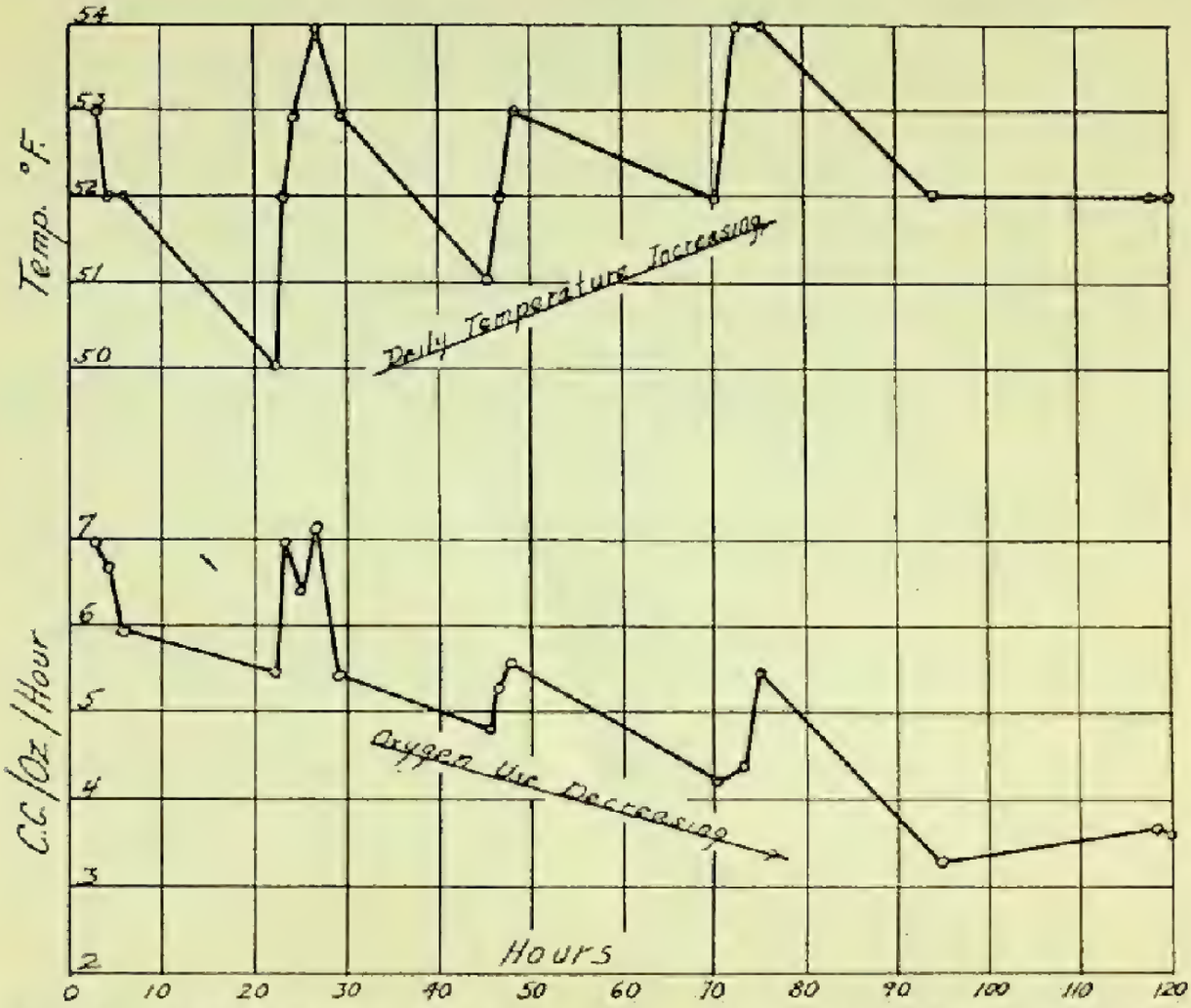

FIG. 3. Oxygen consumption of rainbow trout, 6.4 per ounce: effect of starvation.

from Figure 1 and Table 1 to determine the probable carrying capacity at different temperatures and altitudes. To convert parts per million to cubic centimeters per gallon, multiply the former value by 2.65.

In Table 3 the values in Table 2 have been decreased by 13.25 cc per gallon (equivalent to 5 ppm), which is generally accepted as the minimum at which trout should be held. The figures in Table 3, therefore, show the actual amount of oxygen available for use of fish, as opposed to Table 2, which gives the total oxygen present when fully saturated.

It is noted from this table that at 10,000 feet elevation and 75° F. there is only 10 per cent as much oxygen available for use above 5 ppm as there is at 40° F. and sea level.

In Table 4 the values in Table 3 for available oxygen have been correlated with the oxygen consumption of trout for the corresponding temperatures, and the figures shown indicate the ounces of trout that may be carried in a hatchery trough for each gallon per minute of water flow under varying temperatures and altitudes. Here it becomes evident that the three factors, temperature, altitude and oxygen consumption, all tend to decrease the carrying capacity of water with increase of temper-

ature and altitude. Thus, where one gallon per minute will furnish sufficient oxygen for 400 ounces of trout at 45° F. and sea level, the same quantity of water would only support 14 ounces of trout at 70° F. and 10,000 feet elevation.

TABLE 2

Oxygen Content of Saturated Water in cc Per Gallon for Varying Temperatures and Elevations

Temp., °F.	Elevation in feet										
	0	1,000	2,000	3,000	4,000	5,000	6,000	7,000	8,000	9,000	10,000
40	34.5	33.1	32.0	30.8	29.6	28.6	27.5	26.5	25.4	24.6	23.8
45	32.0	30.9	29.7	28.6	27.8	26.7	25.7	24.6	23.8	23.0	22.3
50	29.9	28.9	27.8	26.8	26.0	25.0	24.1	23.0	22.3	21.5	20.7
55	28.1	27.3	26.2	25.1	24.4	23.6	22.5	21.7	20.9	20.1	19.4
60	26.5	25.4	24.6	23.6	22.8	22.0	21.2	20.5	19.6	18.8	18.0
65	24.9	24.1	23.3	22.3	21.5	20.7	19.9	19.1	18.5	17.7	16.9
70	23.8	23.0	22.3	21.1	20.7	19.6	19.1	18.3	17.8	16.9	16.1
75	22.8	22.0	21.2	20.4	19.6	18.8	18.0	17.2	16.7	16.1	15.4

TABLE 3

Oxygen Content of Saturated Water in cc Per Gallon Available Above 5 PPM

Temp., °F.	Elevation in feet										
	0	1,000	2,000	3,000	4,000	5,000	6,000	7,000	8,000	9,000	10,000
40	21.2	19.9	18.8	17.5	16.4	15.4	14.4	13.3	12.2	11.4	10.6
45	18.8	17.8	16.6	15.4	14.6	13.5	12.4	11.4	10.6	9.8	9.0
50	16.7	15.7	14.6	13.5	12.7	11.7	10.9	9.8	9.0	8.2	7.5
55	14.8	14.0	13.0	11.9	11.2	10.4	9.3	8.5	7.7	6.9	6.1
60	13.2	12.2	11.4	10.3	9.5	8.8	8.0	7.2	6.4	5.6	4.8
65	11.7	10.8	10.0	9.0	8.2	7.4	6.6	5.8	5.3	4.5	3.7
70	10.6	9.8	9.0	8.0	7.4	6.4	5.8	5.0	4.5	3.7	2.9
75	9.5	8.7	8.0	7.1	6.4	5.6	4.8	4.0	3.4	2.9	2.1

TABLE 4

Trough Carrying Capacity in Ounces of Trout Per Gallon Per Minute of Water Flow. Inlet Water Saturated. Outlet Water Oxygen Content 5 PPM

Temp., °F.	Elevation in feet										
	0	1,000	2,000	3,000	4,000	5,000	6,000	7,000	8,000	9,000	10,000
45	400	380	350	330	310	285	265	240	225	210	190
50	210	195	180	170	160	145	135	120	110	100	95
55	132	125	116	107	100	93	83	76	69	62	55
60	93	85	80	72	67	62	56	50	45	39	34
65	66	61	57	51	46	42	37	33	30	25	21
70	52	48	44	39	36	31	28	24	22	18	14

For troughs in tandem the total for the two troughs may be increased 10-15 per cent above the values tabulated in Table 4, provided good aerators are installed between the upper and lower trough. (The reader is referred to the article by Paul A. Shaw on Hatchery Trough Aerators, California Fish and Game, 1936, vol. 22, no. 2, pp. 126-136.) At the lower temperatures and altitudes actual crowding of fish would become a limiting factor rather than available oxygen. Thus at 45° F. and sea level 20 gallons per minute would supply 8,000 ounces with sufficient oxygen, but that weight of fish would require more than a standard tandem trough to prevent overcrowding. For economy and efficiency of operation, the table suggests that at low temperature and altitude hatcheries the ratio of trough and pond space to total water flow should be high, while high temperature and altitude hatcheries should be provided with a low ratio of trough and pond space to available water supply.

Data from Table 4 have been recalculated as shown in Table 5 to give the gallons of water per minute required for 1,000 ounces of fish. This form is probably more convenient for practical use.

TABLE 5

Minimum Water Requirements in Hatchery Troughs in Gallons Per Minute for Each 1,000 Ounces of Trout *

Temp., °F.	Elevation in feet										
	0	1,000	2,000	3,000	4,000	5,000	6,000	7,000	8,000	9,000	10,000
45	2.5	2.7	2.9	3.0	3.2	3.5	3.8	4.2	4.5	4.8	5.3
50	4.8	5.4	5.6	5.9	6.2	6.9	7.4	8.3	9.1	10.0	11
55	7.6	8.0	8.6	9.3	10	11	12	13	15	16	18
60	11	12	13	14	15	16	18	20	22	26	29
65	15	16	18	20	22	24	27	30	33	40	48
70	19	21	23	26	28	32	36	41	45	55	71

*Values above 10 are only shown to the closest gallon. For tandem troughs with good aerators between upper and lower, the water requirements can be lowered about 10 per cent.

The water requirements indicated in the table may be utilized also for evaluating the efficiency of tank trucks with a water circulating system. Thus, at 50° and sea level five gallons in circulation should carry 1,000 ounces and 30 gallons should carry 6,000 ounces if 100 per cent reaeration efficiency is secured. If the truck under the above conditions is found to handle only 3,000 ounces, the recirculation aeration efficiency must be about 50 per cent.

The tabulated figures are not applicable to rectangular or circular ponds since reaeration from the surface and the water jets becomes large in comparison to oxygen directly available from the water supply. While no exact data are available, it is believed that circular pond carrying capacity can be approximated by increasing the tabulated figures in Table 4 by 20 per cent (effect of jet aeration), multiplying by the total gallons per minute of water flow, and then for each 100 square feet of surface area adding the number shown in the following table in accordance with existing temperature and altitude to secure the total carrying capacity in ounces. For rectangular tanks calculate as above but do not

add 20 per cent to Table 4 values since inlet water at the upper end of such tanks will not cause reaeration at this point unless the inlet supply is under-saturated. In circular ponds the inlet jets discharge into partly depleted water and create an appreciable reaeration of the pond water.

TABLE 6

Carrying Capacity of Ponds From Surface Aeration Alone When Pond Concentration Stays Constant at 5 PPM. Ounces of Fish Per 100 Square Feet of Surface

Temp., °F.	Elevation in feet										
	0	1,000	2,000	3,000	4,000	5,000	6,000	7,000	8,000	9,000	10,000
45	670	640	590	560	520	480	440	410	380	350	320
50	350	330	300	285	260	240	220	200	185	170	160
55	220	210	195	180	170	155	140	130	115	105	90
60	155	140	135	120	110	105	95	85	75	65	55
65	110	100	95	85	80	70	60	55	50	40	35
70	85	80	75	65	60	50	45	40	35	30	25

As an example, a circular pond of 700 square feet surface, 50° F., 2,000 feet elevation and 30-gallon-per-minute flow would carry:

$(180\times30)+.2\ (180\times30)+7\times300=5{,}400+1{,}080+2{,}100=8{,}580$ ounces

or 42,900 fish at 5 per ounce.

With 2-foot depth, this would be about five fish per gallon.

The actual volume of a pond, as represented by increasing depth, has no bearing on its carrying capacity except when space requirement becomes a limiting factor rather than oxygen supply. This would be the case in low temperature and altitude facilities as was previously discussed under the topic of ratio of carrying space to water supply at varying temperatures and altitudes.

Table 6 is based on a reabsorption value of 60 pounds oxygen per acre per 24 hours at 45° F. at sea level, and at an oxygen content of 5 ppm. For higher temperatures and elevations the absorptions are calculated in proportion to the values shown in Table 3 (oxygen in cc/gallon available above 5 ppm). Various investigators have previously shown that oxygen reabsorption is directly proportioned to the per cent of deficiency. Further detailed studies on the carrying capacity of ponds in relation to oxygen supply and reabsorption would be desirable.

The preceding tables on water requirements assume that the inlet water is substantially saturated with oxygen and that the final minimum oxygen value is to be 5 ppm. When an analysis shows under-saturation of the inlet water a correction must be applied as shown by the following example:

Saturation value	10 ppm	
Actual observed value	8 "	
Desired minimum value	5 "	
Theoretical value available	5 "	(10-5)
Actual value available	3 "	(8-5)
Carrying capacity	3/5 of table value	
Water required	5/3 of table value	

TRESPASS [1]

By ROBERT W. KENNY
Attorney General, State of California

Every unauthorized entry upon the land of another is a trespass. Though the injury be slight, the law allows damages for it.

There is a big difference, however, between civil trespass and criminal trespass as those terms are generally understood. The main difference is that no trespass is a crime unless declared so by statute. Thus, every trespass carries with it the possibility of civil liability, but does not necessarily jeopardize one criminally unless the trespass is denounced by statute as a crime. You can be sued for all trespass in the civil courts. Nominal damages, usually $1 to $10, are allowed for trespass if the land owner or occupant suffers no actual loss or injury. Compensatory damages are allowed where he is actually damaged or suffers a loss. In some cases, exemplary or punitive (punishing) damages will be allowed where the trespass is committed through malice or aggravating circumstances. For example, in the early California case of *Waters* v. *Dumas*, decided in 1888 (75 C. 563), punitive or exemplary damages were awarded against a trespasser who maliciously took down, removed and carried away the front door of a house, dismantled and made off with the windows, and stuffed the flues of the chimney so as to prevent the escape of smoke. Even after the property owner had tacked cloth over the windows to keep out the cold, the trespasser tore it down. It requires no stretch of the imagination to view such circumstances as aggravating. From the sportsman's standpoint, trespass might be aggravating if he deliberately chopped down an apple tree, pulled up tomato vines or corn stalks, or shot the farmer's cow.

Financial liability for actual damage in a civil action for trespass is in no way dependent upon the intent or motive with which the trespass is committed. Motive is important only in determining whether exemplary or punitive damages should be awarded. The courts have said that absence of bad faith can never excuse a trespass, although the existence of bad faith may sometimes aggravate it. Hence, it is important for everyone to be sure of his legal right before he invades the possession of another.

It should be remembered that if a trespasser injures the property of another, the latter can obtain compensatory damages through the courts for the actual loss suffered, even though the damage was done unintentionally. For illustration, we need only go back to the farmer's cow. If a hunter shot the cow accidentally, he would be liable to the farmer for the value of the cow. If, on the other hand, he shot the cow intentionally or maliciously, the farmer could recover not only the value of the cow, but might also be awarded punitive or exemplary damages for such maliciousness.

No person has the right to enter upon the lands of another to fish even though the waters running through such property have been stocked by the State.[2] Thus, if both banks of a stream are privately owned, the

[1] A speech given before the convention of Associated Sportsmen of California on October 23, 1943, Santa Cruz, California. This exposition of the trespass laws is published in an effort to clear up some of the misunderstandings which still exist in the minds of sportsmen and of the general public.—*Editor.*

[2] It is the policy of the Fish and Game Commission not to stock waters that are posted; or to permit stocking on any private property unless at least one-third of the water is open to public fishing, except in the case of ponds so small as to be obviously unable to support public fishing. Where waters which have been stocked while open to the public are later closed by private owners, the State is without recourse.—*Editor.*

owners or occupants can keep you from angling. In most instances where the lands border a stream with different owners on each side, ownership extends to the center or to one side of the stream. Consequently, the stream itself is also private, and an unauthorized entry thereon, even in a boat or canoe, would constitute a trespass. Furthermore, when such conditions exist the owner or occupants have the right to fence off the stream and keep the public out. The same is true where the stream runs through the lands of but one owner. There are few exceptions to this rule, namely:

1. Where the stream is navigable. There are about 45 sloughs, rivers, streams and lakes in California that are navigable, and description of them can be found in the Harbors and Navigation Code, Sections 100-107.

2. Where the lands adjoining a stream or lake were public property in 1910. All State lands sold to private parties since 1910 reserve to the public the right to fish from them.

3. Where the banks of a stream or lake, privately owned, have been condemned by county boards of supervisors and purchased for the benefit of the fishing public. Procedure for such a purchase by the counties is set forth in Section 4085½ of the Political Code of this State.

The Fish and Game Code also provides that the owner of any dam shall accord to the public for the purpose of fishing, the right of access to the waters impounded by the dam during the open seasons. This is subject to such rules and regulations as the Fish and Game Commission may prescribe (Section 531, Fish and Game Code).

Trespass on privately owned beaches is governed by the same rules as trespass on any other property. But as private ownership of the beaches does not extend below mean high water mark, you would not be a trespasser if you were in the water immediately off such beaches below the mean high water mark. The same applies to navigable streams, sloughs, rivers and lakes.

In so far as criminal trespass is concerned, certain portions of Section 602 of the Penal Code define what trespasses are crimes. They should interest the hunter and angler, and, at the risk of omission, I have condensed some of them. Any one of the following acts is a crime:

(a) Cutting down, destroying, or injuring any kind of wood or timber standing or growing upon the lands of another.

(b) Carrying away any kind of wood or timber lying on such lands.

(c) Maliciously injuring or severing from the freehold of another anything attached thereto, or the produce thereof. (That means tearing up fences, gates, growing crops, etc.)

(f) Maliciously tearing down, damaging, or destroying any road sign or signboards placed upon any property belonging to the State, or to any city, county or village by the State or by an automobile association, or signs relating to fires or fire control, or any other matter involving the protection of the property.

(g) Entering upon oyster beds or lands where other shellfish are planted; or injuring, gathering, or carrying away any oysters or shellfish planted, whether such lands are covered by water or not, without permission of the owner or legal occupant; or destroying or removing any stakes, fences, or signs designating the boundaries of any such lands.

(h) Wilfully opening, tearing down, or otherwise destroying any fence on the inclosed land, or opening any gate, bar, or fence of another and wilfully leaving it open without the written permission of the owner, or maliciously tearing down or destroying any sign or signboard forbidding shooting on private property.

(i) Building fires upon any land where signs forbidding trespass are displayed at intervals not greater than one-third mile along the exterior boundaries, and at all roads and trails entering such lands, without first having obtained written permission from the owner or occupant.

(k) Entering any lands under cultivation or inclosed by fence; or entering upon uncultivated or uninclosed lands where signs forbidding trespass are displayed at intervals not less than three to the mile along all exterior boundaries and at all roads and trails entering such lands, for the purpose of hunting, shooting, killing, or destroying any animal or bird, without having first obtained written permission from the owner or occupant of such lands.

In the latter instance you will note there is no specific reference to fishing, but the phrase "destroying any animal" is broad enough to include fishing.

The important thing to remember is that entry on *inclosed* or *cultivated* lands for any purpose is a misdemeanor; and that trespass on *uninclosed* or *uncultivated* lands properly posted against hunting or fishing is a misdemeanor.

Section 627 of the Penal Code also affects sportsmen. It reads in part as follows:

"Every person who for the purpose of hunting, pursuing, taking, killing or destroying any animal or bird, enters upon any lands under cultivation or enclosed by a fence, or enters upon any other lands or upon the canal banks or rights of way of any irrigation district, where signs are displayed not less than three to the mile along all exterior boundaries and at all roads and trails entering such land, canal banks or rights of way forbidding such trespassing, without the written permission of the owner of such lands or irrigation district or the agent or the person in lawful possession thereof, or who maliciously tears down, mutilates, or destroys any sign, sign-board, or other notice forbidding hunting on such lands, canal banks, or rights of way, is guilty of a misdemeanor. * * *"

This section is inapplicable, however, to those who enter such lands for the purpose of communicating with the owner or lawful occupant. Moreover, it does not apply to employees of the State or of the United States engaged in the destruction of predatory animals. The section also makes it a misdemeanor for any person to post any sign indicating that his property is a State or Federal game refuge when, in fact, it is not. Note also that under this section it is a crime to enter on the canal banks or rights of way of an irrigation district to fish if such are posted against trespass.

It might be well to emphasize that the only instance where a person hunting or fishing would not be committing a criminal trespass by entering the lands of another without written permission is where he entered *uncultivated* or *uninclosed* lands which were *not* posted against such entry.

Within the restrictions of the game laws, any person has a right to take and kill game at any place where he may lawfully go, but the public

has no right to invade or cross private lands in order to reach public lands or navigable waters for the purpose of hunting (*Bolsa Land Co.* v. *Burdick*, 151 Cal. 254). In fact, no person has any right to trespass on the premises of another for the purpose of hunting (*Forestier* v. *Johnson*, 164 Cal. 24).

The exclusive right to hunt upon game preserves is recognized as a property right, and trespass on said preserves may be enjoined or prevented by recourse to the courts.

In the early case of *Kellogg* v. *King*, 114 Cal. 378, an action was brought by the trustee of a hunting club to prevent hunting thereon by an organized group of trespassers. In deciding the case, the court used the following language, which is pertinent here:

"* * * The wild game of the State, it is true, belongs to the people in their sovereign capacity, and is not subject to private dominion to any greater extent than the people through the legislature may see fit to make it. (Ex parte Maier, 103 Cal. 476; 42 Am. St. Rep. 129.) But the legislature has seen fit to prescribe the limit where public proprietorship ends and that of the individual commences; and when within the provisions of such statute, an individual is as much to be protected in the enjoyment of his rights in this species of property as in any other under the law. Section 656 of the Civil Code provides that: 'animals wild by nature are the subject of ownership while living only when on the land of the person claiming them, or when tamed or taken and held in the possession, or disabled and immediately pursued.' While these wild birds, therefore, are within the plaintiff's inclosure, he has under this statute such rights in them as entitle him to protect them from invasion by those not authorized to be there, and any person violating such rights is as much a trespasser as though entering unbidden the plaintiff's dwelling."

Since every landowner has an exclusive common-law right to kill or capture game on his own land subject to the regulatory laws, the State can not, within constitutional limits, by the issuance of hunting licenses which purport to give a hunter the right to invade the hunting grounds, authorize one to enter another's premises for the purpose of taking game without the latter's permission (24 Amer. Jur. 377).

In short, a State license to hunt does not confer any right upon the licensee to enter lands owned by private parties without their permission (*Diane Shooting Club* v. *Lamoreux*, 89 N. W. (Wis.) 880).

In concluding, I hope you will not get the notion that the laws are all against you, or that I am General Gloom instead of General Kenny, or that you should stow your fishing gear and shooting irons in moth balls. I have merely pointed out the hazards and dangers of trespass. Actually, criminal prosecution for trespass rarely occurs unless the trespass is aggravated. I appreciate it is not practical for you to secure the written permission of a landowner while you are busily chasing a deer through enclosed pasturage. And from the landowner's standpoint, it may not be practical for him to waste the time and trouble to attempt to prosecute you criminally for such an act.

In fine, the laws against criminal trespass are like the sword of Damocles. They hang over your head continually, but seldom fall.

THE NOSE BOT FLY OF DEER [1]

By CARLTON M. HERMAN
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In the nasal passages and throat of deer, hunters frequently observe yellowish, worm-like creatures or grubs. These are the larval or maggot stage of a fly. The details of the life history of these insects is not known, but it is believed that the flies lay their eggs in the nostrils of the deer during the spring and summer. The eggs hatch out as small maggots and in this stage have been found in the nasal cavities, throat, lungs, and even in the stomach and intestines. As they reach maturity they are found chiefly in the nose and nasal passages. It is thought that when fully mature they escape from the deer and remain in a non-motile stage (pupa) on or in the ground. After a period of time the adult fly emerges from the pupal case.

There have been many theories and suggestions on the harm these maggots cause to deer. However, little factual information is available to prove or disprove any of these various conjectures. Cases of "craziness" in deer, due to the presence of these nasal bots, have been recorded. It has been suggested that on occasion the maggots penetrate the skull and enter the brain, with drastic results. Sneezing fits, sometimes observed in deer, are probably attributable to an effort to become rid of these parasites. Whether or not further investigation should prove that these fly maggots cause injury to the tissues of deer or even in extreme cases result in death of the animal, it is evident that they are capable of causing annoyance and considerable irritation to the infected animal.

FIG. 4. Nose bot fly maggots from nasal sinus of deer (From Herms).

The mature maggots (Fig. 4) are usually more than half an inch long and may attain a length of as much as an inch and a half. Nothing is known of their length of life in the deer. As they reach maturity the maggots, which have been yellow in color, develop a more pronounced black pigmentation. The pupal case is black, hard, and brittle, and is about the size and shape of the general outline of the maggot. The pupal period may last as little as 21 days, but many more specimens will have to be reared to determine the range of variation for the full development of this stage.

[1] Submitted for publication October, 1945.

Very few of the flies have been successfully reared in captivity. Those raised from reindeer in Alaska and from deer in Montana and Michigan belong to the same genus as one reared successfully in our laboratory (Herman, 1945, Pan-Pac. Ent., 21 :120). At least two species are thought to occur in California deer, *Cephenemyia pratti* and *C. jellisoni*. The adult (Fig. 5) is a large bumblebee-like fly. It has been suggested that these flies are capable of flight speeds approaching 800 miles per hour, although this is still a subject of controversy. The great speed of these flies and the difficulty of rearing them in captivity probably account for the fact that so few adults are available for study and so little is truly known of the details of their life history.

The species of these maggots which occur in deer are known only from deer and have never been reported from man or any other species of animal except deer. The maggots do not occur in muscle tissue and in no way affect the palatability of the meat.

FIG. 5. Adult fly (*Cephenemyia jellisoni*).

WARM-WATER FISH MANAGEMENT [1]

By A. S. Hazzard
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As suggested in the two preceding articles,[2] planting fish to establish a new and needed species, i. e., stocking for introduction, is quite different from annual restocking with the expectation of increasing the species already present. This is termed stocking for maintenance.

Introduction of Warm-Water Fish

Much good has been done by introducing desirable game and pan fish in streams and lakes where these fish were not originally found. Although early records of natural fish distribution in Michigan are sketchy and incomplete, there is not much doubt but that bass, bluegills, and pikeperch (walleyes) were not found in many northern waters until after they were planted. Arbutus Lake, Grand Traverse County, for years famous for its large bluegills, had none of these fish prior to about 1920, if the reports of the older residents of this area are reliable. It is also reported that bass and pikeperch were not found in the entire Michigamme River system above Peavy Falls (near the mouth) before they were introduced. Many other examples of the lack of desirable game and pan fish in isolated lakes and river systems above natural barriers have been cited. Even today we know of waters which need planting in order to establish bass, pike, pikeperch, bluegills or other fish. In some cases only a single game or pan fish species is present, although the lakes should be able to support several kinds of fish and fishing would undoubtedly be better. In other cases pan fish only are present and are stunted, presumably for lack of a predatory game species to keep their numbers down. However, these waters are relatively few in Michigan at present because of the rather wide natural distribution of fish and because of the energy displayed in the past by fish-culturists and by local sportsmen in stocking isolated waters.

In a recent review of experimental management recommendations for 255 lakes in various parts of the State, in which careful surveys of the fish and conditions for fish life have been made, it was found that new warm-water species were recommended in the case of 25 lakes, or approximately 10 per cent. For all other species in these lakes and for all species in the remaining 90 per cent natural spawning was considered adequate and no further planting was recommended.

Stocking of warm-water fish is also needed in lakes, mostly in southern Michigan, which "winterkill" periodically. Intensive netting in 16

[1] Reprinted from *Michigan Conservation*, September, 1945. In some parts of the United States black bass and other spiny-rayed fishes are much more important factors in the sport fishery than they are in California, and for this reason have been the subject of much more intensive study than they have here. While conclusions reached elsewhere obviously will not apply in entirety in California due to different environmental conditions, still the general principles may be expected to be valid. In the belief that these principles will be of vital interest to California sportsmen, this report by the director of one of the outstanding fisheries research organizations in the country is published here.—*Editor.*

[2] The two preceding articles had to do with general policies and with trout management.—*Editor.*

of 51 lakes where heavy losses of fish were reported this past winter showed that few if any large-mouth bass or bluegills had survived the oxygen depletion which resulted from the unusually prolonged and deep snow cover. Restocking to establish these species was recommended for most of the public lakes on the list since in the interval between winterkills (nine years) bass and bluegills had furnished good fishing. This type of stocking might be termed "re-introduction." Such planting can be justified in lakes where winterkill, or more rarely kill by pollution, is of infrequent occurrence. Re-establishment of bass and bluegills by transfer of a few breeders from nearby lakes might prove to be more economical and effective than stocking with hatchery-reared fingerlings. At least one year would be gained in the recovery of such lakes by releasing adult fish.

FIG. 6. Warm-water fish netted from overflows which later dry up have been used in California to introduce desirable species into waters where they were not present.—Photo by C. A. Woodhull.

Another possible value of continued re-introduction of warm-water fish has been found where pan fish (bluegills, sunfish, perch, etc.) are stunted even though bass are present. These particular lakes have poor or no spawning grounds for northern pike or for pikeperch. Annual plantings of fingerling pikeperch or northern pike might control the populations of pan fish and improve the growth rate and add to the quality of the fishing. However, this theory needs to be proved by experiments before being adopted as a management policy.

Unfortunately, as stated in Mr. Westerman's article which preceded this series, introduction of new warm-water species has not always been done wisely or with good results. Near the close of the last century carp were brought over from Europe and were enthusiastically planted in nearly all accessible waters. It is indeed fortunate that good roads were not present then, otherwise few lakes and streams would have been missed. It is now recognized that this introduction was a serious error in most cases. Carp roil the water and in other ways interfere with the production of better food and game fish.

FIG. 7. Black bass from Fresno County, California.

The widespread transfer of perch mostly from the fall "runs" into the rivers tributary to the Great Lakes has established this species in a number of actual or potential trout waters. In such waters perch reproduce abundantly but rarely reach a desirable size. Little success has been achieved in planting such waters with trout—even trout of legal size—as long as perch are present. Plantings of bluegills, sunfish, bass, and pikeperch have also been made in trout waters generally by or at the behest of enthusiastic but poorly informed sportsmen or resort owners. Results are deceptive as the fish planted thrive and reach good size, but when they start to reproduce stunting occurs, trout disappear, and usually after a few years the lake produces no fish of decent size. All fish must then be removed before trout can be replanted successfully, and this is a difficult and expensive operation.

Attempts to introduce new species or to increase the abundance of those present by stocking have frequently resulted in establishing undesirable fish by accident. Green sunfish and longear sunfish (the former rarely and the latter never reaching legal size in Michigan) have become mixed with plantings of bluegills. Pumpkinseed sunfish, less desirable than bluegills, have also been introduced in this way. Sometimes this occurs because the young of these fish enter bluegill rearing ponds through the water supply. At some hatcheries it is virtually impossible to keep them out. Occasionally in the past it has happened that inexperienced fish culturists collected the young of these fish, mistaking them for bluegills. In other cases sportsmen or resort operators have seined young fish from a lake or stream and have transferred their entire catch

to another water thinking that they were doing good. Goldfish from the family bowl or from careless fishermen have found their way into some lakes and streams. All of these fish may interfere with good fish production just as weeds in a garden reduce the crop of vegetables.

The addition of new species in order to "add variety" to the fishing has upset the natural balance in many waters, generally resulting in poor fishing for both the native and the introduced forms. The formerly widespread planting of crappies in Wisconsin lakes has been blamed for the decline in bass fishing which has resulted in certain lakes in that State. It is becoming recognized that, except in the larger lakes, a combination of two or three warm-water species, for example, largemouth bass and bluegills, usually gives the best fishing. Much more needs to be learned about the relationship between different species, but such experiments should be carried on in waters which can be controlled and where the results can be carefully checked.

In order to avoid introducing new species unsuited to the waters, fisheries surveys have been carried on in Michigan and other States for a number of years. Only when the basic physical, chemical, and biological facts about a lake or stream have been determined is it possible to intelligently manage the water for fish production. With a knowledge of the temperature, depth, bottom types, oxygen supply, kinds of fish, potential food production, etc., many of the errors common in the past can be avoided. Such information is also needed to explain existing fishing conditions and to suggest management practices which may improve fishing.

Stocking for Maintenance

Planting of fingerling bass, bluegills, perch, pikeperch and other warm-water fish in waters now containing them is believed to be valueless or actually harmful. This statement is supported by the following facts:

(1) Large number of young fish produced by natural spawning

That an enormous number of eggs is deposited and hatched is indicated by the following counts of the average young fish production per nest: large-mouth bass, 6,022; rock bass, 1,466; pumpkinseed sunfish, 6,012; bluegill, 16,277. Survival to the adult stage of any but a small fraction of the above numbers obviously would be impossible. In northern pike the average survival to the size at which migration from the marsh occurs was estimated to be only 0.23 per cent, but the average production of eggs per female was found to be 32,200.

Recovery of the complete fish population in a small Michigan lake after four years of counting the number of nests and young of largemouth bass, bluegills, pumpkinseed sunfish, and rock bass yielded figures which emphasize this natural mortality from the baby fish to the adult. At the end of four years only three bluegills, five pumpkinseed sunfish, 30 rock bass, and 13 largemouth bass of each 100,000 fry estimated to have been produced in the first year of the study had survived! While it is true that the major part of the loss occurs in the younger stages, the figures showed heavy losses in each succeeding year. It is believed that there are natural limitations to the number of fish of various sizes which a body of water can support. It, therefore, seems logical to assume that if more young fish are produced naturally than can live to maturity,

plantings of hatchery fish would merely increase the competition. Any planted fish which survived would do so at the expense of naturally spawned young.

The ratio of the number of young-of-the-year to the number of adult fish in lakes from which complete fish populations have been removed indicates that plantings of bass and perch fingerlings would have to be at the rate of about 2,000 to the acre in order to increase the number of legal-sized fish by one fish per acre—assuming that the waters could support the additional fish (which assumption we do not believe is true).

Whereas conditions in the Great Lakes are doubtless somewhat different from those in inland waters, it is significant that research workers have found no correlation between the commercial catch of pikeperch and the number of fry planted.

Research in other States also indicates poor returns from warm-water fish plantings. Ohio reports less than 0.03 per cent caught by anglers and only 0.5 per cent of the anglers took any of the planted fish. From Oklahoma comes the statement that the catch of fish has not been in proportion to the number planted—stocking at the rate of 300 fish per acre produced no noticeable increase in the catch. More general statements of the same nature have been made by workers in other States.

(2) Large numbers of breeders even in heavily fished lakes

"Winterkill" on six southern Michigan lakes this past year (1945) showed an average of 150 adult game fish per acre to have been present and subsequent checks have proved that this kill was not complete in most cases.

Poisoning of 18 lakes to restock with more desirable species yielded an average of 69 legal-sized game fish per acre. (In most of these lakes the fish were stunted and many under legal length were mature.) It is obvious that there were more than enough breeders to fully stock all of these lakes with young.

Creel census on a number of Michigan lakes has revealed an average of 36 adult game fish caught per acre per year. These fish were present as breeders during the preceding spawning season and alone would have restocked the lakes. Fisheries biologists from Alabama report that heavy fishing with no closed season, daily limits, or size limits removes only 50 per cent of the adult fish.

(3) Ability to spawn in varied habitats and (for bluegills) extended spawning season

Largemouth bass have been found to reproduce successfully over gravel or any other bottom type where roots of water plants furnish support for the eggs. The same is true for bluegills and pumpkinseed sunfish. The spawning season of bluegill extends from mid-May to early August, so that if for any reason the eggs of the first spawning fail to develop the later spawning will maintain the stock. Perch reproduce in any lake whether or not weeds are present. Smallmouth bass, northern pike, and pikeperch appear to have more specialized spawning requirements, which probably accounts for their limited distribution in certain parts of the State. However, as stated earlier, it is believed that a limited number of fish species generally provides the best fishing except in large lakes. There should, therefore, be no need for annual plantings

of warm-water fish which can not reproduce in order to add variety to the catch. For example, why should smallmouth bass be stocked regularly in a lake lacking gravel bottom since the largemouth is a very satisfactory substitute which will maintain fishing by natural spawning? Why plant pikeperch in a lake where they can not spawn if northern pike or bass are present and are providing good fishing?

(4) Evidence from growth studies

Perch, bluegills, sunfish, rock bass, pikeperch, and pike have been found to be stunted in certain lakes due to over-population from natural spawning. This stunted condition has been found most commonly in the case of the first three species listed. A 50 per cent reduction in the population of rock bass in a Michigan lake caused greatly increased growth rate which has continued for four years, resulting in some satisfactory fishing where before nearly all fish were undersized. Other reductions in population from partial "winterkill," poisoning, or loss from disease have invariably produced improved growth and better fishing for several years, i. e., until natural reproduction overstocked the lakes with small fish.

(5) Good fishing and no lack of small fish in spite of no stocking

A number of important Michigan lakes have been in the "Pike Lake" classification for many years and were, therefore, not planted with bass and bluegills. Fishing for bass and bluegills has been as good or better than that recorded for lakes which were regularly planted with these species. Houghton and Hamlin lakes are two examples which may be cited.

Starting in 1937, recommendations against further plantings of warm-water fish were made where lake surveys disclosed (as they invariably did) adequate breeding stock and good spawning conditions for suitable species. Michigan, therefore, now has at least one hundred important lakes which have not been planted with warm-water fish for periods varying from two to eight years. Because of the war, checks have been made on only a small number of these to date, but seining, other netting, and observation on these have shown no lack of young game fish. In fact, any observant fisherman may readily satisfy himself as to the presence of young fish if he will look carefully around the shores and the docks of his favorite lake. If he attempts to seine minnows for bait in almost any Michigan lake, he generally takes as many or more small bluegills, sunfish, perch, rock bass, and even bass as he does minnows. Young pike and pikeperch are harder to seine along shore, but their presence can generally be demonstrated if one is persistent and knows where to find them.

Certain game and pan fish, such as northern pike, rock bass, crappies, bullheads, and ciscoes, have rarely if ever been planted in Michigan lakes within the last 20 years, yet they continue to maintain themselves in goodly numbers.

(6) Danger of introducing parasites and disease

As in the case of trout, warm-water fish plantings have spread disease. "Black spot" and "yellow grub" parasites may have been distributed somewhat by stocking, but since a part of their life cycles is

in fish-eating birds, these parasites would have reached most waters without the help of man. Where conditions are suitable for the snails, which are the third link in the life cycles, the fish are more or less "grubby." These worms apparently do little harm to the fish and can not infect man. The "bass tapeworm" is much more of a menace to fish, although it, too, can not infect man. Carried only by fish and certain water fleas, its original distribution in Michigan was restricted. Planting infected bass, perch, and bluegills (any of which may carry the larval stage) has increased the range of this tapeworm until at present many waters are contaminated with this parasite. It makes the fish much less attractive to anglers, and when the infection is severe may sterilize the bass. While it is possible to raise tapeworm-free fish, this is not always practicable or easy, especially if the water supply is infected. Lymphocystis, a virus disease of fish, causes ugly, gelatinous growths on the body and fins of pikeperch. It has been introduced into Gogebic Lake and possibly into other waters by planting of infected fry from Saginaw Bay, where this disease is common. The constant danger of spreading parasites and other diseases in public waters is a strong argument against continued stocking.

(7) Plantings not needed "to bring in new blood"

The argument has sometimes been made that hatchery plantings are needed to improve the growth and quality of game fish in a lake. There is no evidence that such is the case. Many of the lakes where stocking has been most persistent now contain stunted bluegills. While the number planted was probably not sufficient to have caused the stunting, obviously the introduced fish did not prevent it. On the other hand, the transfer of stunted bluegills to lakes from which all fish had been removed resulted in rapid resumption of growth, proving that slow growth was due to an overcrowded environment rather than to heredity.

Must Fish Planting Be Continued for Psychological Reasons?

The argument is sometimes made that plantings must be continued because the public generally believes they are of value. One official of a "booster club" admitted privately to a State official that the main reason his organization wanted fish planted was so they could publish the figures in hopes of attracting more fishermen to that region!

In the early days of doubt as to the value of fish plantings certain conservation men wedded to planting had consoled themselves with the rather cynical thought that even if fish plantings weren't doing any good, at least they weren't doing any harm. If the evidence here presented is sound, much harm has been done by unwise plantings, and if the species stocked were already present, energy and money were wasted which might have been spent to better purpose.

What Can Be Done to Make Better Fishing?

Lest the reader think that research on warm-water fish has been entirely destructive and completely adverse to planting, he is reminded that much good can be accomplished by wise introduction of suitable stock in waters lacking the proper species.

Improvement of the environment for warm-water fish can increase the yield just as in the case of trout, but fisheries men need more knowledge of the habits and requirements of fish and of the conditions existing in Michigan's many lakes and streams before waters can be intelligently managed for better fish production. More information from carefully controlled practical experiments on selected lakes and streams is needed to determine the value and practicability of such things as fertilization, brush shelters, population control, and other management practices which have been suggested. More facts can make better fishing.

EDITORIALS AND NOTES

NOTES ON THE FORMER PRESENCE OF GRIZZLY AND BLACK BEARS IN MARIN COUNTY, CALIFORNIA

Recent articles in California Fish and Game on the subject of grizzlies have led me to record information concerning the former presence of grizzly and black bears in Marin County. There appear to be no definite records of bears in Marin County in the scientific literature, although there are some for adjacent Sonoma County. My information, based on interviews and correspondence with old-time residents and on articles in old journals, indicates that grizzlies probably occurred in the county and that black bears certainly did.

Grinnell (Review of the recent mammal fauna of California, p. 97. Univ. Calif. Publ. Zool., 40: 71-234. 1933) gives the range of the grizzly of the northwest coast belt of California as "unknown; probably northwest coast belt generally. An old record, likely for this race of grizzly, is for Petaluma, Sonoma County (Baird, Pac. R. R. Rept., 8, 1857, Mammals: 225). Now long extinct." The presence of grizzlies at a locality so near to Marin County, together with the absence of any physical barrier and the presence of suitable habitat in Marin County, lends support to my not entirely satisfactory records concerning this species. One reference is present on pp. 124-125 in the "History of Marin County, California" (J. P. Munro-Fraser, Editor. Alley, Bowen and Co., 1-xv—16-516 pp. 1880). This describes the roping, probably in the 1850s, of a grizzly on the sand dunes of Tomales Bay by one "Tom Vaquero," a colorful character of the early days. The truth and accuracy of the reference are not beyond question, however, and the emphasis is on the roping rather than on the animal. Since the story is interesting it is repeated here.

"We can not better close this sketch than with Tom Vaquero's recital of his adventure with a grizzly bear.

"Once while riding over the low, rolling sand-dunes skirting Tomales Bay, he discovered a large grizzly in a little valley or flat, quietly feeding upon the clover. With *riata* gyrating over his head, he swooped down upon bruin, and with unerring precision hurled the noose around the bear's neck. With the other end of the *riata* given a few turns around the horn of his saddle, and a horse that had been thoroughly trained as a *lass* animal, he considered himself entirely master of the situation, and concluded to take the bear home and picket him out. By sometimes driving, then again dragging, he had got the bear within half a mile of home, when the grizzly lost his temper and showed fight. As at every step the horse took he sank to his fetlocks in the sand, an hour's struggle with the bear had nearly exhausted him. The grizzly had now become the attacking party, and it required skillful maneuvering to keep out of his reach. In the excitement Vaquero's raw-hide *riata* got caught in a half-hitch

around the horn of his saddle, and he could not cast it loose. The bear, as if realizing his advantage, sat down on his haunches and methodically commenced taking in the slack of the *riata* with his paws, as a man would a rope, hand-over-hand. He had already pulled in half of the 50-foot *riata,* and Vaquero said he could see deliberate murder in the grizzly's eyes. The case was becoming desperate, when Vaquero bethought himself of his sheath-knife, and with it succeeded in severing the wiry rawhide coil which had fouled on the horn of his saddle. Thus freed, he beat a hasty retreat, leaving the bear victor of the field and winner of a *riata* worth at that time not less than ten dollars."

A more recent possible record is supplied by Mr. John Mazza, of San Francisco, who, when a child, lived in the settlement of Tocaloma, on Papermill Creek. In a recent letter to me Mr. Mazza mentions a bear which was seen in that neighborhood about 1884 and states, "As to whether the bear seen was black or grizzly, I have no positive recollection except that the term 'grizzly' stands out more prominently in my memory than 'black,' and that it was the more dangerous variety, namely, the grizzly."

Grinnell, Dixon and Linsdale (Fur-bearing mammals of California, pp. 97-98. Berkeley, Univ. Calif. Press. 2 vols. 777 pp. 1937) give the range of the black bear on the northwest coast of California as "Northwestern coastal region south from the Oregon line to the vicinity of the Gualala River in Sonoma County. * * * Formerly, before 1876, common around Bodega, Sonoma County."

My records for black or brown bears are more numerous and more positive than for grizzlies and indicate that this species ranged south through Sonoma and Marin counties as far as the northwestern margin of San Francisco Bay. An article in the *Marin County Journal* of September 28, 1862, states "A young man named Allen killed a brown bear and cubs on Tuesday last, near Tamalpais." An article in the same periodical for May 9, 1863, reads: "Brown bears are becoming quite bold and annoying to the people about Olema and Punta Reyes. We are informed that four entered the yard in front of the house of Mr. Jewel of Olema and attempted to capture some geese. The men around the place, however, frightened them to the hills. They took from Mr. Gordon a quarter of beef—from Mr. Olds and others, pigs and calves, and seem to be playing rebellism generally in the neighborhood."

Mr. W. I. Pixley, a longtime resident of Corte Madera, Marin County, recalls having seen bears on a number of occasions, and describes them as small brown bears with a few black ones also present. This description indicates that the bears seen by Mr. Pixley, as well as the "brown bears" reported in the *Marin County Journal,* were black bears with the brown color phase predominating. Mr. Pixley, who spent his youth on a ranch in what is now Chevy Chase Park, reports having seen bears in Marin County on the divide between Larkspur Creek and Blythedale Canyon, near the old mill in the present city of Mill Valley, and at the head of Steep Ravine, seeing the last animal in about 1888. In his opinion, the bears were rather inoffensive beasts which did relatively little damage to stock, a description which would be appropriate for the black bear, but hardly for the grizzly.

The presence of black bears in Marin County, apparently in considerable numbers at one time, appears to be something of a variation from the usual relations of distribution of black bears and grizzlies. Marin County, with a relatively far greater area in chaparral than in forests, seems to offer a better environment for grizzlies than for black bears. Since black bears in California did not ordinarily occupy territory inhabited by grizzlies, it appears strange that, as the records indicate, black bears were more numerous. One possible explanation is that few records exist for the Mexican period, during which time destruction of grizzlies as a stock menace may have been extensively carried out. This would have enabled the black bear population to increase and to spread into areas formerly occupied by grizzlies, a phenomenon which occurred at other places in California. The subsequent disappearance of the black bear from Marin may be attributed to intensive hunting in the relatively restricted chaparral and forest area in Marin County, and the relative isolation of this area from similar habitats to the north.

In the absence of specimens, the racial identity of the bears in Marin County can not be stated with certainty. Probably the black bears were the southernmost members of the northwest coast race (*Ursus americanus altifrontalis*), so that it may be assumed that, in California, this race formerly inhabited the entire northwestern coast belt from the Oregon line to the Golden Gate, with San Francisco Bay serving as the barrier which prevented it from invading similar territory to the south. The same situation would also apply to the form of grizzly (*Ursus mendocinensis*) which inhabited the same general area.—*C. E. Van Atta, Museum of Vertebrate Zoology, Berkeley, California, May, 1945.*

TWENTY-FIVE YEARS AGO IN CALIFORNIA FISH AND GAME

The January, 1921, issue of California Fish and Game was designated a "Salmon number," and contained articles dealing with the life history, the artificial propagation, and the capture of the Pacific salmons. In the intervening 25 years much has been added to our knowledge, although much still remains to be learned. More important from the practical point of view, there has been established the principle that the runs of anadromous fishes up our rivers constitute self-perpetuating resources of such value that they must be taken into account in the construction of dams or other obstacles to their existence.

It has taken much labor to bring about public recognition of this principle—labor on the part of commercial fishermen, of sportsmen, and of professional fisheries investigators. For a long time this labor produced but little in the way of tangible results, but in the last 10 years the tide has turned. Bonneville Dam was the first major structure—in this part of the world, at least—where thought and money were expended on a major scale for the protection of fish. The problems at Grand Coulee and Shasta Dams, both too high for fishways, have been met in a different way; to what extent these conservation programs will be successful remains to be seen, for it has yet to be proved that a large salmon run can be maintained by artificial propagation, but in any case a major effort has been made. And now it is proposed to write into the law of the land the requirement that any report to Congress on government dam-building projects shall include as an integral part surveys to be made by fish and

wildlife investigators on a par with and at the same time as the engineering survey. This is S. 924 introduced by Senator Guy Cordon of Oregon, and should receive the active support of all sportsmen.

In California steps have been taken which, while less spectacular than the Bonneville fishways or the Grand Coulee and Shasta salvage programs, should be none the less effective in the cause of salmon conservation. Dams have been forever prohibited on the Klamath River by a referendum of the people. Commercial salmon fishing has been eliminated in the Klamath and Eel Rivers. And the size of the salmon run in the San Joaquin River system, which had been thought to be almost extinct, has been shown by recent investigations of the Bureau of Marine Fisheries to be very considerable. If the careful plans of that bureau, which are based largely on proper screening of diversions and on proper releases of water below recently constructed or projected dams, can be carried out, these runs can be saved and perhaps even increased.—*Brian Curtis, Editor, California Fish and Game, October, 1945.*

NOTES ON AN EPIZOIC ALGA

In April, 1944, Mr. Jules Periat of San Mateo, California, discovered in his fish pond some mosquito fish (*Gambusia affinis affinis*) with small growths of algae attached to them. Samples of these fish were sent to Dr. Gilbert M. Smith of Stanford University and to the writer. Dr. Smith identified the algal filaments as belonging to the genus *Stigeoclonium,* close to or identical with *S. aestivale.* It became apparent on closer observation that the alga was not attached to the fish directly but to parasitic copepods of the genus *Lernaea.* These "anchor parasites" are rather common upon many species of fishes, usually in warmer waters. The copepod shown in the accompanying illustration was

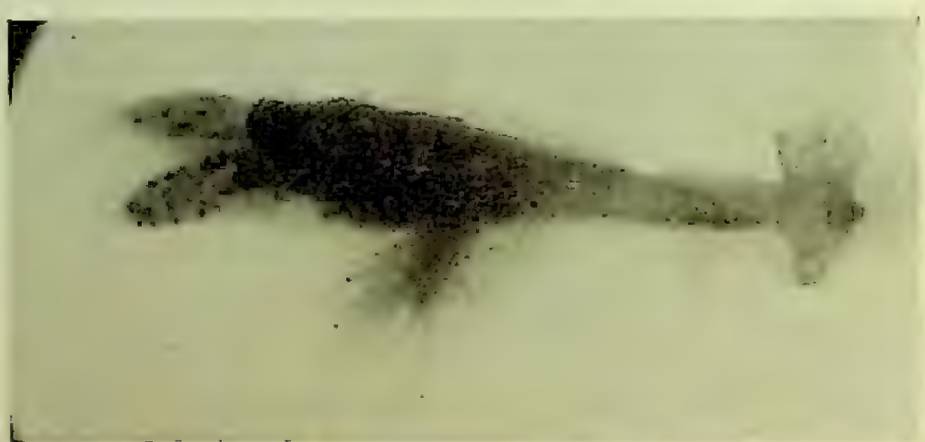

FIG. 8. Parasitic copepod (*Lernaea*) with alga (*Stigeoclonium aestivale* (sp?) epizoic upon it.

anchored to the base of the ventral fins but they may attach themselves to almost any part of the fish's body. Dr. Smith expressed the view that this alga was epizoic on the *Lernaea* rather than parasitic. This is borne out by an examination of micro-sections made by the writer. The algal filaments do not penetrate completely through the tough skin of the anchor parasite, rather the penetration seems to be just deep enough to provide a secure attachment. Smith (The Fresh-Water Algae of the United States. 1933) states that "*Stigeoclonium* is a common alga in slowly flowing clear-water brooks, in springs, and in the overflow from

fountains and watering troughs. This alga * * * usually grows affixed to stones, woodwork or submerged aquatics * * *" As far as the writer is aware, this is the first reported instance in which an alga occurred epizoic upon *Lernaea*. Cases have been reported where algae were attached to turtles and to plankton crustaceans and the writer has seen desmids attached to the heads of the copepod *Salmincola*, parasitic on the gills of rainbow trout.—*J. H. Wales, Bureau of Fish Conservation, California Division of Fish and Game, July, 1945.*

FUNGUS IN AIR BLADDER OF STRIPED BASS

On July 11, 1945, Mr. G. F. McClatchy of San Francisco caught a 27-inch striped bass off Belvedere Point, San Francisco Bay. In the air bladder was found a considerable quantity of an amorphous spongy, brown substance. Upon microscopic examination, it was found that this was a firm mass of fungus mycelia intermixed with bacteria. It is not known whether the deep brown pigment was originated by the fungus or the bacteria. Apparently this fungus is neither *Saprolegnia parasitica* nor *S. invaderis*, which are common on fish and one of which the writer has found in the air bladder of trout fingerlings.—*J. H. Wales, Bureau of Fish Conservation, California Division of Fish and Game, July, 1945.*

STURGEON FROM SHASTA LAKE

The writer had been informed by two people during the past year that they have seen sturgeon in the newly formed Shasta Lake. It was commonly known that sturgeon existed in the Pit River before the Shasta Dam was built, and Exhibit No. 1 at the Mt. Shasta Fish Hatchery is a seven-foot sturgeon netted six years ago in Squaw Creek, a tributary to the Pit River. It was no great surprise, therefore, when the writer and his companion, Mr. Charles Salinas, found a white sturgeon (*Acipenser transmontanus*) near the head of the Pit River arm of Shasta Lake on July 13, 1945. This specimen measured 7 feet 8 inches total length and weighed 145 pounds. It was still alive when found, but was floating belly up and soon died. Upon dissection, it was found that a tumorous growth had developed at the junction of the stomach and intestine and had almost completely occluded the passage. Gas had developed in the stomach and had made this great fish quite helpless. This appears to be the first sturgeon taken from Shasta Lake and it is undoubtedly the largest fish recorded from that body of water.—*J. H. Wales, Bureau of Fish Conservation, California Division of Fish and Game, July, 1945.*

AN ALBINO CALIFORNIA SARDINE

An albino sardine (*Sardinops caerulea*) was taken off Santa Cruz, on Monterey Bay, on the night of August 28, 1945, by the purse seine boat "Key West." The specimen was noted and saved by a crew member, Horace Giamona, following a haul on a school of sardines.

This fish, instead of being characteristically dark blue-green above, was a bright lemon-yellow color, speckled with fine blackish dots. The large blackish spots on the sides were lacking. The sides and undersurface were a brilliant silvery hue. This silvery sheen appeared to be in the outer skin covering the scales, because where scales had been

rubbed off a yellowish color was evident. The dorsal and caudal fins were bright lemon-yellow margined with black, while the fins on the underside were colorless.

Aside from the unique coloration, the fish appeared to be normal in other respects. The specimen was a female, 188 millimeters, body length, or 8¾ inches, total length, and examination of the scales showed that it was approaching three years of age. Although this is a little smaller than average for a fish of this age, still it is well within the normal size range for this group.

In CALIFORNIA FISH AND GAME, Vol. 15, No. 2, p. 176, April, 1929, M. J. Lindner has a note on an albino sardine, also from Monterey Bay, taken on September 18, 1928.—*J. B. Phillips, Bureau of Marine Fisheries, California Division of Fish and Game, September, 1945.*

PHEASANTS FLOWN TO GUAM

On July 1, 1945, 60 10-week-old Mongolian pheasants were flown from the holding pens of the State Division of Fish and Game at Sacramento to Guam, in the Marianas Islands. This shipment was made at the request of Admiral Chester W. Nimitz, who was of the opinion that

FIG. 9. Release of pheasants on Guam.

food, cover, and water conditions on Guam were ideal for pheasants. Other favorable factors were the absence of predators and the lack of other upland game birds to furnish competition.

The pheasants, 17 cocks and 43 hens, were shipped in five crates, 12 birds to the crate, carried in the forward belly compartment of an R5D (C-47) transport. They were not fed en route, but were watered in the Hawaiian Islands and again on arrival at Guam. They were in the crates a total of 57 hours, of which 31 hours were airborne. Flight altitudes ranged from 7,500 to 8,500 feet, with maximum and minimum outside air temperatures of 92° and 52° F. The total distance traveled exceeded 6,200 statute miles.

Ninety per cent of the birds reached Guam in excellent condition. One cock and one hen were dead on arrival, with a third dying. Three other hens were in a weakened condition with only a 50-50 chance of survival. The pheasants were liberated four to five hours after arrival. They were split into two groups and turned loose about 10 miles apart in two different and distinct types of terrain. The birds seemed healthy and lively, many taking off and flying short distances to cover upon being released from the crates.—*Janet Quinn, Bureau of Fish Conservation, California Division of Fish and Game, October, 1945.*

REPORTS

FISH CASES

July, August, September, 1945

Offense	Number arrests	Fines imposed	Jail sentences (days)
Abalones: undersize, overlimit, transporting abalones, from District 2½ through District 2 without an affidavit	59	$1,752 50	
Angling: night fishing, other than hook and line, overlimit, no license, fishing 150 feet lower side of dam, illegally caught fish, more than one rod and line, fishing other than angling, closed waters, failure show license on demand, fishing too close to dam and on fish ladder	139	1,777 50	
Bass and Sturgeon: undersize, overlimit, no license, at night, more than one line, protected	65	2,540 00	35
Catfish and Spotfin Croaker: selling, closed season	5	210 00	
Clams: undersize and overlimit	13	230 00	
Commercial: gill net on boat in District 2, fishing with set lines, selling halibut, no license, taking kelp bass, no packers license, using drag net in bay, illegal net	28	2,245 00	
Crabs: undersize, female, closed season	7	105 00	
Frogs: undersize and over limit	1	25 00	
Lobsters: closed season, overlimit, out of shell, undersize	9	655 00	
Salmon: snagging, overlimit, no license, spearing, at night, closed area, artificial light	19	825 00	60
Sunfish: overlimit, more than one line, operating trap, no commercial license	9	192 50	
Trout: overlimit, 2 rods, closed season, ship more than 2 limits in 7 days, closed stream	27	540 00	
Totals	381	$11,397 50	95

GAME CASES

July, August, September, 1945

Offense	Number arrests	Fines imposed	Jail sentences (days)
Antelope: transfer permit	1	$50 00	
Deer: using A tag in District 1¾, taking forked horn deer District 1¾, failure to complete deer tag, using 1944 deer tags, purchase deer, fawn, female, spotlighting, night hunting, failure to tag, doe, no deer tags, refuge, shooting from public road, refuse to show license on demand, using tags of another, mutilating deer tag	123	11,225 00	30
Deer meat: closed season, illegal possession	27	2,200 00	
Doves: unplugged gun, no license, closed season, shooting from auto and overlimit	44	2,115 00	
Ducks: closed season	4	325 00	
Firearms: refuge	21	490 00	
Hunting: shooting from public road, no license, shooting game birds from vehicle	16	406 00	
Pheasants: hen, closed season, no license, shooting from vehicle	56	4,400 00	
Pigeons: closed season	1	25 00	
Quail: closed season, no license	3	135 00	
Rabbits: closed season, no license, shooting from vehicle	18	517 00	
Trapping: no license	1	15 00	
Totals	315	$21,903 00	30

SEIZURES OF FISH AND GAME

July, August, September, 1945

Fish:

Abalones	669
Bass, black	230
Bass, striped	223
Carp, lbs.	40
Catfish, lbs.	50
Clams	422
Crabs	170
Halibut, lbs.	60
Lobster, spiny	519
Lobsters, spiny, lbs.	50
Lobsters, spiny, sacks	14
Salmon	34
Salmon, lbs.	390
Spotfin croaker, lbs.	360
Sturgeon	3
Sunfish	82
Trammel net	2
Trout	456
Trout, lbs.	40

Game:

Deer	33
Deer meat, lbs.	676½
Deer meat, quarts	8
Doves	534
Ducks	13
Pheasants	27
Pheasants, hen	43
Pheasants, male	30
Pigeons	3
Quail	9
Rabbits	31

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(Continued from inside front cover)

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R. Nickerson, Supervising License Agent ..... Los Angeles
Lorraine Atwood, License Agent ..... San Francisco

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L. F. CHAPPELL, Assistant Chief of Patrol ..... San Francisco

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Orben Philbrick, Warden, San Luis Obispo County—Paso Robles
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Erol Greenleaf, Warden, San Bernardino County—Big Bear Lake
Otto Rowland, Warden, San Bernardino County—Victorville

MARINE PATROL

C. H. Groat, Inspector in Charge—Terminal Island
Ralph Classic, Captain—Monterey
T. W. Schilling, Captain—San Francisco
Kenneth Hooker, Warden, Launch *Minnow*—Tiburon
Bolton Hall, Warden—Tiburon
Walter Engelke, Captain and Warden, Cruiser *Bonito*—Newport
Lars J. Weseth, Captain—Terminal Island
Robert Mills—Newport
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Leslie E. Lahr, Warden—Wilmington
Ralph Miller, Warden—San Francisco
G. R. Smalley, Warden—Richmond
T. J. Smith, Warden—San Diego
Carmi Savage, Warden—Santa Monica
R. C. Schoen, Warden—Terminal Island
John Barry, Warden—Terminal Island
J. Ross Cox, Warden—Watsonville

MARINE PATROL AND RESEARCH BOATS

Cruiser *Bonito*, Newport Harbor
Cruiser *Rainbow III*, Antioch
Cruiser *Shasta*, Redding
Launch *Shrapnel*, Suisun
Launch *Minnow*, San Rafael

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